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Economic Impacts of the Wide Area Vehicle Monitoring System

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Abstract:	The analysis of the secondary economic impacts of the Wide Area Vehicle Monitoring System (WAVM) development and implementation was completed using the input-output model framework. The Transport Impact Model (TRIM), developed by the Research and Development Branch of MTO was used to model the Ontario Economy. The WAVM system will provide real-time truck location, identification and two-way message communication services between the equipped trucks and the trucking company base station. The WAVM development and implementation involves both a research and development phase (Phase I) and an implementation phase (Phase II). Estimated spending in Phase I is $15.6 million over a two-year period (1988/89-1989/90), while spending in Phase II (purchases of equipment and services by system users) is estimated to be $49.3 million over a five-year period (1988-1993). The estimated total impacts of the above spending include approximately 2100 person-years of employment, labour income of about $54 million and total income, Gross Domestic Product, of about $110 million. Total tax revenues generated by the system during these two Phases are about $23 million, with about $8 million accruing to the Government of Ontario and about $4 million to local governments in Ontario. Other impacts include imports from other provinces of about $11 million and an equal amount of imports from abroad. Of total gross sales of $143 million, about 60% occur in manufacturing and 40% in services, which include purchases of telecommunications services by system users in Phase II.
Comments:	For more information on TRIM see R&D Report Number EC-88-01 "General Economic Stimulation and Energy Indicators for Capital Investment Initiatives in Various Transportation Modes." For more information on the WAVM project, please contact Mr. Joe Tsai of Transportation Technology and Energy Branch at (416)235-3453.
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Executive Summary

The Wide Area Vehicle Monitoring system, WAVM, development and implementation, as proposed by the potential equipment suppliers and the service provider, involves both a research and development phase (Phase I) and an implementation phase (Phase II). Estimated spending in Phase I is $15.6 million over a two-year period (1988/89-1989/90), while spending in Phase II (purchases of equipment and services by system users) is estimated to be $49.3 million over a five-year period (1989-1993). The estimated total impacts of the above spending include approximately 2100 person-years of employment, labour income of about $54 million and total income, Gross Domestic Product, of about $110 million. Total tax revenues generated by the system during these two Phases are about $23 million, with about $8 million accruing to the Government of Ontario and about $4 million to local governments in Ontario. Other impacts include imports from other provinces of about $11 million and an equal amount of imports from abroad. Of total gross sales of $143 million, about 60% occur in manufacturing and 40% in services, which include purchases of telecommunications services by system users in Phase II.

1/ Introduction

This report deals with the evaluation of the secondary Economic Impacts of the Wide Area Vehicle Monitoring (WAVM) system project [1]. The WAVM project itself was initiated by the Transportation Technology and Energy (TT&E) Branch of the Ministry of Transportation with the following objectives:

- Increase the efficiency and competitiveness of the Ontario highway transportation industry through the use of satellite technology.
- Support the development of a new Canadian high technology industry to serve the emerging WAVM market.

The WAVM system will allow truck fleet management at the base station to locate a truck and communicate with the driver at will. It will allow trucking firms to better utilize their fleets and, thus, to increase their business opportunity and reduce their cost. The project is divided into two phases.

Phase I involves:

- development and construction of 15 mobile terminals and a hub station (Phase I - Manufacturing),
- development of associated software and communication links (Phase I - Research and Development),
- testing, using fleets of two Ontario trucking firms (Phase I - Testing).

The total spending on all components (manufacturing, research and development and testing) of Phase I will be approximately $15.6 million over the period 1988/89-1989/90.

Phase II is an interim field trial which includes:

- production of 3000 mobile terminals for users (Phase II - Manufacturing);
- provision of "Fleetstar" communication services to these users (Phase II - Services).

The total spending in Phase II has been estimated to be $49.3 million over the period 1989-1993. The specific assumptions concerning each component of the project are described in detail in Section 4.

Economic impacts of the development and implementation of the WAVM system can be classified into two categories:

- the cost saving to the users of the system, primary impacts, which also corresponds to increased efficiency for the economy as a whole;*
- other economy-wide impacts associated with spending on the project, secondary impacts, such as employment and income.

This report deals only with secondary impacts. Transport Impact Model, TRIM [2-5], has been used for the estimation of these impacts. The basis of the TRIM is an input-output model of the Ontario economy developed by Econometric Research Limited. The evaluated impacts are total income, GDP, labour income, employment, imports, gross sales and taxes in Ontario associated with spending on the project. These secondary impacts are discussed in Section 2. Specific assumptions of the TRIM system are discussed briefly in Section 3.

2/ Economic Impacts

Economic impacts have been estimated for each component of the project. These estimates are presented in Table 2. Total impacts and impacts for each phase of the project are presented in Table 1. All impacts refer to the province of Ontario only. Thus, for example, the employment impact refers only to employment in Ontario and does not include employment generated in other provinces. All impacts refer to the relevant time period. For example, the total employment impact reported in Table 1 indicates the number of person-years of employment over the 6-year period, 1988-93. Dollar values are all measured in prices as of December 1987 and are added over the relevant time periods with no discounting. Each impact is discussed briefly below.

Gross Domestic Product, GDP, measures the total income generated by production activities. It includes all indirect taxes, labour income and the operating surplus of all production establishments. Over the full 6-year period of the program the total GDP associated with the project is estimated to be $110.8 million, approximately 1.7 times the total initial spending and 7 times the development spending in Phase I. Labour income is a component of GDP and is about 50% of GDP.

* For more information on primary impact contact MTO's Transportation Technology and Energy Branch.

The total employment impact over this period is about 2100 person-years, or about 350 jobs per year. Approximately 32 person-years of employment are associated with each $1 million of initial spending and 134 person-years of employment with each $1 million of development spending.

Imports represent goods and services purchased from other provinces and abroad. The imports from the other provinces totalled to a substantial $10.9 million.

Gross sales represents the value of all goods and services sold at all stages of production by production units in Ontario. These are estimated to total $142.7 million for the entire project; approximately 60% in the manufacturing sector and 40% in the services sector, including purchases of communications services by system users in Phase II.

Tax impacts affect personal taxes, indirect business taxes, tariffs, corporate profits taxes, and property and business taxes. These accrue to local governments in Ontario ($3.7 million), the Ontario provincial government ($7.8 million), and the federal government ($11.2 million). The taxes accrued in the other provinces and associated with the impacts due to exports to Ontario are not included in the calculation. Impacts associated with Phase II are approximately 3 times those associated with Phase I. It must be remembered, however, that Phase II impacts are spread over 5 years (1989-1993) while Phase I impacts are spread over a 2-year period (1988/89 - 1989/90).

Within Phase I, the impacts of the two main elements are approximately equal, except for gross sales which are substantially larger for the manufacturing component than for the component. This difference occurs because the initial spending in the manufacturing component is entirely on goods and services, while only 40% of the initial research and development spending is on purchases of goods and services.

Within Phase II, the impacts of provision of services are approximately twice those of manufacturing. However, the latter are concentrated in a 3-year period (1989-1900) while the former are spread over a 5-year period (1989-1993). the total of the Services column in Table 2 represents provision of services in Phase II.

3/ The TRIM Input-Output Model

The core of the TRIM model is a closed input-output system for Ontario. The closed input-output model is described in the Statistics Canada catalogue, "The Input-Output Structure of the Canadian Economy." The data describing the structure of the Ontario economy is based on the 1979 interprovincial input-output tables compiled by Statistics Canada. (The next version of these tables, for 1984, will be available sometime in 1988.) Price indexes for each industry and commodity, published periodically by Statistics Canada, are used to adjust this data set for changes in relative prices which have occurred between 1979 and the end of 1987. This adjustment does not, however, capture changes in the basic production structure of Ontario which have occurred between 1979 and 1987. These remain a potential source of error.

The use of an input-output model to calculate impacts is based on the assumption that there is enough idle or under-utilized labour and production capacity to supply the required goods and services without changes in relative input prices. This is likely to be true if the project expenditures are small, relative to the total Ontario economy, and if there is excess productive capacity in Ontario. Both assumptions appear to be satisfied by this project.

4/ WAVM Expenditures

The detailed data required to specify the initial expenditure vectors are used as inputs to the TRIM model [2-3]. The Wide Area Vehicle Monitoring project mainly involved three types of expenditure: the development of the system and associated equipment, the manufacture of the equipment, and the on-going provision of communication services. With the exception of the system testing component, a minor expenditure in the project, the input data available and obtained from the relevant businesses did not provide sufficient details to break down expenditures into 43 commodities and 5 primary-input classifications used by the TRIM. Thus, it was necessary to assume that the expenditure patterns in the components of the project were the same as in the most appropriate industries from the L-aggregation of the 1981 input-output data for Canada. The L-aggregation is the most detailed industry breakdown available. The industries used were:

- the communications equipment industry, number 106, for the development and manufacturing of equipment in both phases of the project;
- the communications services industry, number 159, for the on-going provision of services in Phase II.

The data supplied by the trucking companies involved was used to specify the inputs for the Phase I testing component.

The 1981 input-output expenditure patterns for the two industries, 106 and 159, were adjusted to 1987 values using price indexes for each component of the use matrix except operating surplus.Each industry gross output was adjusted to a 1987 value using the corresponding industry selling price index. Then the operating surplus was calculated as the residual, equal to the 1987 value of industry gross output and the sum of the 1987 values of use matrix components. This procedure parallels the method used by Statistics Canada to produce constant price input-output tables. The resulting 1987 expenditure patterns were scaled by the total initial spending on each component, in order to produce the needed expenditure vectors. It was assumed that all communications equipment in these expenditure vectors was purchased in Ontario, but that portions of initial spending on other commodities were imported, according to the proportions in the input-output data.

The initial spending data for Phase II manufacturing was based on assumed sales of 750 mobile units in 1989, 1500 units in 1990, and 750 units in 1991, at a price of $5800 per unit.

The initial spending data for Phase II was based on sales of communications services to owners of the above units at a price of $2580 per year, with the total number of units assumed to remain constant at 3000 through 1993.

5/ References

[1] J. Tsai, "Wide Area Vehicle Monitoring (WAVM) System Project for Ontario's Trucking Industry," Report of Ministry of Transportation of Ontario, 1986.

[2] B.L. Allen, D.W. Butterfield, A.L. Kazakov, M.L. Kliman, A.A. Kubursi and J.D. Welland, "General Economic Stimulation and Energy Indicators for Capital Investment Initiatives in Various Transportation Modes," Report of Ministry of Transportation of Ontario, 1988.

[3] B.L. Allen, D.W. Butterfield, A.L. Kazakov, M.L. Kliman, A.A. Kubursi and J.D. Welland, "Measuring Economic Stimulation From Capital Investment in Transportation," to be published in *Transportation Research Records*, 1988.

[4] B.L. Allen, D.W. Butterfield, A.L. Kazakov, M.L. Kliman, A.A. Kubursi and J.D. Welland, "Transportation Impact Model (TRIM) and its Application to a Financial Decision," RTAC presentation, September 1988, available from Dr. Kazakov, MTO.

[5] "The Input-Output Structure of the Canadian Economy 1971-1980," Statistics Canada, catalogue 15-201.

Table 1: Provincial Impacts by Phase and Total (Millions of Dollars)

	Phase I 1988-90	Phase II 1989-93	Total 1988-93
Initial Spending	15.6	49.3	64.9
Gross Domestic Product	26.7	84.1	110.8
Labour Income	13.9	40.0	53.9
Employment (Person Years)	544	1544	2080
Imports, Total	6.0	15.9	21.9
From Other Provinces	2.9	8.0	10.9
From Abroad	3.1	7.9	11.0
Gross Sales, Total	32.8	109.9	142.7
Primary	0.5	1.4	1.9
Manufacturing	25.6	58.1	83.7
Services	6.7	50.4	57.1
Taxes, Total	5.4	17.3	22.7
Local	0.8	2.9	3.7
Provincial	1.8	6.0	7.8
Federal	2.8	8.4	11.2

Table 2: Provincial Impacts by Components (Millions of Dollars)

	Phase I			Phase II	
	Manufac-turing	(Research & Develm't)	Testing	Manufac-turing	(Services)
	1988-90	1988-90	1988-90	1989-91	1989-93
Initial Spending	8.7	6.6	0.34	17.4	31.9
Gross Domestic Product	14.4	11.7	0.65	28.7	55.4
Labour Income	7.4	6.1	0.38	14.8	25.2
Employment (Person-Years)	291	238	15	580	964
Imports, Total	3.1	2.7	0.17	6.3	9.6
From Other Provinces	1.5	1.3	0.08	3.1	4.9
From Abroad	1.6	1.4	0.09	3.2	4.8
Gross Sales Total	21.3	10.9	0.72	42.2	67.5
Primary	0.3	0.2	0.01	0.6	0.8
Manufacturing	17.4	7.8	0.54	34.4	23.4
Services	3.6	2.9	0.17	7.1	43.3
Taxes, Total	2.9	2.4	0.15	5.8	11.5
Local	0.4	0.3	0.02	0.8	2.1
Provincial	1.0	0.8	0.05	2.0	4.0
Federal	1.5	1.3	0.08	3.0	5.4